

Minnesota



The primary geographic information and GIS activities in Minnesota have been located in the Land Management Information Center (LMIC) and the Department of Natural Resources (DNR). Since July 1991, LMIC has been located in the Department of Administration. Previously, it was in the State Planning Agency where it operated starting in 1977. Originating in 1967 at the University of Minnesota, LMIC has evolved to be both a service center providing GIS services to public agencies and a data clearinghouse. DNR also been an active user of GIS in-house since the early 1980s. LMIC and DNR are two of the largest state centers of GIS activities in the nation. In 1989, two GIS studies were authorized by the Legislature to address DNR and other statewide needs. Reports were prepared late in 1990 providing options, recommendations and priorities regarding data and applications development. An informal GIS/LIS Consortium has existed since 1988 and serves to facilitate coordination among public agencies. The Governor's Council on Geographic Information was established by Executive Order in September, 1991 to lead coordination efforts in the state, including the development of guidelines, standards, a statewide base map, and funding strategies. Following previous expenditures for geographic information, the Legislative Commission on Minnesota Resources decided to embark on and fund a large digital database development effort in FY 1992-93.

1 Origins of State Initiatives

The majority of geographic information and GIS activities in Minnesota have been located in or are in association with the Land Management Information Center (LMIC). Prior to July 1991, LMIC was located in the State Planning Agency, where it provided GIS services to public agencies beginning in 1977.

Minnesota Land Management Information System (MLMIS), the predecessor of LMIC, began in 1967 at the University of Minnesota's Center for Urban and Regional Affairs under contract with the state. It was one of the first state GIS in the country. Most of the MLMIS was initially funded by the State Planning Agency and the Min-

nesota Outdoor Recreation Resource Commission, which later became known as the Legislative Commission on Minnesota Resources (LCMR). The Department of Natural Resources (DNR) and the University also contributed funds to the effort.

MLMIS was initiated as a result of the Lakeshore Development Study which was conducted in response to rapid development of lakeshore areas. One of MLMIS's first products was a land use map to help address this issue. While at the University, the state invested approximately \$2 million in the development of a statewide geographic database at the 1:250,000 scale, and the capability to analyze the data for state resource management programs. This

product became known as the "first generation" database, including 15 layers of data for each of the 1.35 million 40 acre parcels in the state.

MLMIS was transferred to the Minnesota State Planning Agency (SPA) in 1977, and became known as the Land Management Information Center. The focus changed from that of a research center to a data center and service bureau. This allowed for a concentration of technical resources and staff that could provide services to various state agencies, and more recently, local and regional agencies. The service bureau was established to provide computer mapping and spatial analysis services to client agencies on a fee basis, as well as encourage data sharing and integration. When the system was moved to SPA, its annual budget was approximately \$300,000. Resources were provided from the state general fund plus a legislative loan of \$100,000 for the biennium which was paid back with client revenues.

In 1979, LMIC received a \$350,000 appropriation from LCMR to acquire additional hardware to help provide more services for state agencies. During the 1970s, LCMR funded over \$1 million of information development and plans regarding natural resources in LMIC, the DNR and other agencies. Since then, LMIC's system has been maintained and upgraded through client fees. Projects conducted between 1977 and 1982 frequently included development of statewide data layers for long term (2-4 years) projects, some of which were also funded by LCMR. Some of these projects included power plant siting inventory and assessment of acceptable locations, drought impact assessment, a statewide forest inventory co-sponsored by the U.S. Forest Service, a statewide river inventory co-conducted by LMIC and DNR with LCMR funding, and legislative redistricting. Beginning in 1980, it was decided that a "second generation" database at the 1:24,000 scale was needed, but would require much greater effort, resources and multiple sponsors. An incremental approach to meet this need was supported by LMIC though this goal was not officially adopted.

The Department of Natural Resources (DNR) began development of automated information systems in the mid-1970s, with its first Information System Plan in 1982. Tabular databases developed at that time were required to have a geographic reference, based on the 40 acre parcel level in the MLMIS. Early databases operated on the state's mainframe computer, and were then transferred to the DNR's IBM minicomputer purchased for administration purposes. In 1982 the Division of Forestry purchased an in-house Prime 2250 minicomputer for timber inventory purposes, followed by an additional Prime in 1989.

DNR began work with the U.S. Geological Survey's Water Resources Division in 1982 to create a water use database management system to automate database management of water for both state and federal programs. The effort included data aggregation programs, and a simulation model based on Standard Industrial Classification Codes to determine the economic value of water and various utility programs. LMIC assisted in the development of the system.

Beginning in 1983, LMIC's funding mechanism was altered to have a revolving fund. The fund must operate with a positive cash flow, but can carry over funds from year to year. At the same time, LCMR funds grew to support additional data development efforts at LMIC and DNR. By the mid-1980s, LMIC's annual budget was estimated at approximately \$1.2 million, with \$675,000 or 56% of the total budget funded from user fees. At that time the Center had 16 staff members and eight student workers. LMIC's budget and staff stabilized in the late 1980s with an annual budget of \$1.4 million with \$750,000 of the total budget funded from user fees, and 12 staff members with four student workers. With the change in funding structure, the legislature also authorized LMIC by stating in the statutes that the State Planning Agency shall establish LMIC.

LMIC has operated one of the earliest and most extensive state GIS in the country, particularly in terms of state financial commitments, staffing levels and variety of applications.

LMIC efforts conducted since 1984 were characterized by fewer and larger projects that did not have as much value for statewide purposes or contribute to the statewide database as did previous projects. Projects served individual agencies and were more specialized to meet contracting agencies' missions. Examples of these projects included an acid rain analysis to identify potentially sensitive areas, aeromagnetic mapping for the State Geological Survey with LCMR funding, Indian lands dispute negotiations regarding treaty lands and original value for the U.S. Justice Department, and a sewer interceptor system for capital improvement planning and urban growth management for the Metro Waste Control Commission. This trend continued to the end of the decade.

During the late 1980s, other state agencies began acquiring their own capabilities, rather than

continuing to contract with LMIC for GIS services. LMIC had no authority to set statewide standards for accuracy or quality of the raw data provided by users. It evolved to serve as a data clearinghouse, but with no dedicated resources to serve in this role. LMIC also offered information services and some consulting to users, providing some similarity in approach among users. Though LMIC did not have a directive to do so, its activities led to some coordination of GIS activities in the state.

LMIC developed recommendations that its focus should change in response to these trends and growing needs for GIS coordination. These recommendations included the added functions of maintenance of statewide data inventories, serving as a data clearinghouse, monitoring and reporting on statewide trends, technology development and transfer, possibly with a GIS laboratory, and further development of applications services.

With the growing body of GIS users in Minnesota, a Natural Resource GIS Consortium (NRGIS) was organized in the fall of 1988 to improve conditions in the state regarding GIS. Members mainly represent state agencies. Thematic subcommittees were established for individual categories of data with the goal of improving data interchange, prioritizing data development and maximizing cooperative development. Technical subcommittees were also established for specific pilot projects. The NRGIS name was later changed to the GIS/LIS Consortium to reflect a broader mission.

During the first half of 1989, the InterTechnologies Group of the state's Department of Administration granted \$25,000 to the NRGIS to improve interagency coordination and accelerate progress toward statewide geographic data integration. The funding was used to support the *Minnesota Geographic Data Integration Project* and to organize and support the Consortium and its Subcommittees. One of the group's first missions was to inventory available data for use with GIS. Over 135 databases were initially identified, with almost half concerning hydrology. Other efforts included recommending methods for exchange of data, maintenance and updating of data, and standards for data interchange and data classification; as well as a report on the status and direction of geographic data integration. The project resulted in four reports completed in August, 1989. They include an annual report, *Inventory of Digital Data Collections, Recommended GIS Standards, Guidelines, and Procedures: Building a Minnesota GIS Map Library*, and *Minnesota Data Exchange Research Project*.

The 1989 Legislature mandated a study to be conducted on Land Resource Information Systems

(LRIS). The State Planning Agency (SPA) was directed to contract with an independent consultant to explore future directions for Minnesota in LRIS. The scope of this \$50,000 study was specified to include "interagency cooperation, public and private venture potential, the status of GIS planning as it applies to Minnesota, the role that LMIC should play in future development of an overall system, and a long-range strategy for Minnesota's role in providing services to agencies and political subdivisions." It further stated that the study must be accomplished in conjunction with the Information Policy Office (IPO) and must be compatible with the long-range information management architecture being developed by the IPO. A request for proposals was issued and a contract awarded for the study which began in November, 1989.

In addition to the LRIS study, the 1989 Legislature appropriated \$90,000 for the development of a department-wide *Geographic Resources Information Systems Plan* in the Department of Natural Resources. A request for proposals was issued and awarded soon after the LRIS study contract was awarded.

2 Coordination Efforts, Groups and Activities

State geographic information and GIS efforts in Minnesota are led by the Governor's Council on Geographic Information, established by Executive Order signed on September 16, 1991. The Council was established following extensive efforts of members of the Minnesota GIS/LIS Consortium and related efforts to analyze and improve geographic information conditions in Minnesota.

The Council is assisted by the Land Management Information Center (LMIC) and Information Policy Office (IPO), both located in the Department of Administration (DOA), and the Minnesota GIS/LIS Consortium. The Executive Order provides that the Council be composed of not more than 15 members with "knowledge and interest in the GIS field representing state government, higher education, local government, federal government and GIS users in the private sector," to be appointed by the Commissioner of Administration. Nominations for the Council's membership are being solicited. It is expected the Council will meet for the first time in the spring of 1992 and then meet quarterly thereafter. The Executive Order provides that a chair is to be elected by the membership.

The Council is directed to adopt a charter and create topical advisory committees. The Executive Order also states that administrative staff support

be provided by IPO, technical staff support by LMIC, and advice be provided by the Consortium.

The Executive Order directs the Council to prepare an annual report each year, with the first report due by June 30, 1992 including recommendations for legislation to establish a permanent organization to supersede the Council and recommendations for addressing needs described in the Executive Order.

It is envisioned the Council will devise strategies for the development, use, and funding of GIS. It is expected the Council will also direct and oversee the development of a statewide geographic information database and base map, including the creation of statewide data repositories. It will provide a forum for the resolution of conflicts among agencies regarding the acquisition, maintenance and accessibility of geographic information. The Council will help develop and implement statewide standards with IPO (see below). The Council will be responsible for developing GIS development guidelines, recommending funding strategies and identifying funding sources, and ensuring that GIS development conforms to the statewide information architecture being implemented by IPO.

Before the establishment of the Council, coordination efforts were accomplished through the GIS/LIS Consortium, which will support the Council in its efforts. The Consortium was initially established as the Natural Resource GIS (NRGIS) Consortium in 1988 (see **Origins of State Initiatives**). It was created to provide a forum for communicating and sharing information about GIS and Land Information System (LIS) in Minnesota, and continues to provide a linking mechanism among interested entities in the state. It includes representatives of state, federal, regional and local agencies, and universities currently providing, developing, or using natural resource and land records geographic data. Originally called NRGIS, the group's name was later changed to the GIS/LIS Consortium to reflect a broader mission also including facilities management, transportation and demographics.

The Consortium has a steering committee of 20 representatives of public agencies and academic organizations that serves to coordinate consortium activities. Members are state agencies including the InterTechnologies Group and LMIC in the Department of Administration; Department of Transportation (DOT); Department of Natural Resources (DNR); Pollution Control Agency (PCA); the Natural Resources Research Institute, the Board of Water and Soil Resources, the Center for Urban and Regional Affairs, the Remote Sensing Laboratory, and the Soil Science Department at the University of Minnesota; the Geography

Department at Bemidji State University; and regional and local governments including the Minneapolis-St. Paul Metropolitan Council, Ramsey County, Rochester-Olmsted Consolidated Planning Agency, and the St. Louis County Land Department. For FY 1992, the Consortium is chaired by the Ramsey County Surveyor. Officers also include the past chair, the Commissioner of DNR; and the treasurer from PCA, and the secretary from the University of Minnesota.

The Consortium has thematic subcommittees established with the goal of improving data interchange, prioritizing data development and maximizing cooperative development. The subcommittees include Hydrology, Transportation, Soils, Land Use, and Forestry. The Land Use and Hydrology Subcommittees serve as review group for the LCMR projects. Technical subcommittees were also established for specific issues such as guidelines for data exchange.

The Consortium Steering Committee meets approximately four times per year, rotating meeting locations around the state. Workshops and an annual GIS/LIS conference are sponsored by the Consortium, with the second conference entitled "Moving Strategically Into the 1990s" held in October, 1991. The consortium publishes a periodic newsletter titled *GIS/LIS News*.

In addition to the Council and the Consortium, additional efforts are underway to improve coordination among state agencies. For example, a memorandum of understanding (MOU) has been drafted by staff of DNR, PCA and LMIC. It provides for meetings and activities that would be conducted in a collaborative manner, and is expected to be signed by the leaders of these agencies. Discussions are also underway to have an MOU signed by the DOT.

Geographic information and GIS coordination efforts have been traditionally supported by LMIC, which was relocated by statute from the State Planning Agency (SPA) to the Department of Administration (DOA) in July, 1991. LMIC has informally served in a coordinating role providing GIS, mapping, modelling, graphics and database management services for state agencies and other governments since 1977 (see **Origins of State Initiatives**). LMIC also acts as a data clearinghouse, though limited resources have been available for this purpose as LMIC is primarily funded by fees for service. LMIC has operated one of the earliest and most extensive state GIS in the country, particularly in terms of state financial commitments, staffing levels and variety of applications (see **GIS in State Government**).

Various activities and conditions led to the creation of the Governor's Council on Geographic Information and the relocation of LMIC from

SPA to DOA. These conditions and activities beginning in 1990 are summarized below, and previous background is summarized in **Origins of State Initiatives**.

Efforts began in 1990 to complete the two plans authorized by the 1989 legislature concerning statewide Land Resource Information Systems (LRIS) and GIS in the Department of Natural Resources (DNR). Plangraphics, Inc. was contracted to prepare both reports. LMIC and DNR staff, and other consortium members, were actively involved in this effort, particularly the development of the *Minnesota Land Resource Information Systems (LRIS) Strategic Plan*, completed in January, 1991. In addition, DOA's Inter technologies Group granted \$10,000 to the GIS/LIS Consortium in July, 1990 to conduct a pilot project to develop a GIS repository.

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To develop the LRIS plan, interviews were conducted with state, federal and local agencies using and planning to increase GIS activities. These interviews and presentations served to increase interest in GIS across the state. The process of developing the plan helped to focus on critical issues and alternatives for Minnesota's future development of GIS, as well as inventorying existing activities. The plan concluded that Minnesota now faced the challenge of increasing database development, coordination and information clearinghouse functions to meet the emerging needs of state and other entities. Identified objectives included development of geographic information databases for the entire state, a cooperative relationship with the public and private sector, and definition of roles with establishment of a governing organizational structure and funding mechanism for statewide GIS.

An action plan was proposed in the plan along four tracks including: 1) database development with standards and a database catalog; 2) services to expand the service bureau to include clearinghouse, consulting and training functions; 3) technology transfer; and 4) management, in-

cluding planning and coordination of policy and procurement.

Database development was a major need identified in the plan. It concluded that an increased effort needed to be made on development of geographic information databases for the entire state, particularly at the 1:100,000 and 1:24,000 scales. Core database elements were proposed and prioritized. In addition, the plan identified and prioritized applications that needed to be developed, as well as sharing mechanisms between agencies. Previously, a "Minnesota Geographic Data Integration Project" was undertaken by the GIS/LIS Consortium in 1989 with a \$25,000 grant from DOA's Inter technologies Group which produced four reports (see **Origins of State Initiatives**). The project was conducted in part to inventory and analyze needs for digital data, which was also a major focus of concern at the time. The report entitled *Inventory of Digital Data Collections* includes a summary listing of available data layers by theme, including hydrology, transportation, wildlife, soils, land use/land cover, land net, forestry, and minerals. On behalf of the GIS/LIS Consortium LMIC developed status maps of digital data at the 1:100,000 to 1:24,000 scales. The results of this work identified the need for a combined vector-raster "second generation" database at a scale of 1:24,000. Following this database inventory and analysis effort, the Legislative Commission on Minnesota Resources (LCMR) decided to embark on a large digital database development effort in FY 1991-93 (see **GIS in State Government**).

Three alternative organizational structures were proposed as stages of evolution to a recommended alternative. The plan recommended that the LMIC service bureau staff and facilities be moved to DOA's Inter Technologies Group which provides central information technology services for state agencies. The move was made effective July 1, 1991. It also recommended that GIS policy and coordinating functions ultimately be located at DOA's Information Policy Office which coordinates statewide information policy and planning.

Federal and Local Relations

State agencies are working with federal agencies regarding GIS in a variety of projects. Official agreements are being established in this regard, including one between the U.S. Soil Conservation Service, LMIC and the University of Minnesota for development of digital soils data. The DNR has some agreements with the U.S. Fish and Wildlife Service, with one specifically addressing GIS. Signed in late 1990, it provides that the two agencies will work together in developing GIS, and hold joint meetings and educational sessions as part of their work together. It also provides that

they will identify joint projects, and seek cooperative agreements and funding for development of baseline data.

Local governments are becoming increasingly involved in the state's geographic information efforts. LMIC has provided some assistance and training for local governments on a fee basis in recent years. LMIC also plans to include counties in standards and database development efforts. The Metropolitan Council contracted with LMIC to create the Twin Cities Land Use and Infrastructure Data Base. LMIC prepared a land use inventory of the equivalent of 50 topographic quadrangle maps as part of the project. Subsequently, the LMIC also created an infrastructure database and a map atlas entitled *Natural Resource Handbook: Land Use and Natural Resource Inventory and Trends*, for the Metropolitan Waste Control District. DNR's Geological Survey has a cooperative funding project with counties to conduct bedrock, surficial and hydrogeology mapping. The counties and the state each pay half of mapping costs.

Unique to Minnesota is the Intergovernmental Information Systems Advisory Council (IISAC) formed in the late 1970s. IISAC facilitates communication between state agencies and local governments regarding information systems, and serves as an ombudsman for localities relating to state government. It is comprised of seven representatives from state agencies and 18 from local governments. IISAC is funded by general appropriation and is administratively located in IPO with two staff members. IISAC efforts include providing grants and support for software useful to local governments.

Policies/Standards

LMIC has established a *Billing Policy and Rate Schedule*. It provides for clients to pay for services, and encourages the development of data that meets interagency needs. For example, priorities might be higher and charges less if a project contributes to "common pool" databases, geographic coverages or has major significance to the state.

Efforts are currently underway to address standards as part of Minnesota's statewide GIS efforts. The *Minnesota Geographic Data Integration Project: Report #3—Recommended GIS Standards, Guidelines, and Procedures: Building a Minnesota GIS Map Library* report was produced in 1989 to address this issue. The report recommended that LMIC establish a Minnesota GIS Map Library on a fee-for-service basis. It also included recommended data classification and documentation standards, data interchange standards, definition and procedures; and coordinates, control and projections.

The Consortium effort also produced a report

testing data exchanges entitled the *Minnesota Geographic Data Integration Project: Report #4—Minnesota Data Exchange Research Project*. This report reviewed the project's activities including documenting and evaluating data exchange translators. Translation, system and procedural problems were identified, and questions for further research were identified.

3 GIS in State Government

GIS activities in Minnesota primarily occur in the **Land Management Information Center** (LMIC), located in the Department of Administration's (DOA) InterTechnologies Group (InterTech), and the Department of Natural Resources, with increasing efforts in other state agencies.

DOA includes both InterTech and the Information Policy Office (IPO). InterTech is responsible for providing information technology services for state agencies, and is funded on a fee for service basis. IPO directs statewide information policy and is responsible for development of the state's information architecture and related standards. It is funded by general appropriation.

LMIC was relocated by statute from the State Planning Agency (SPA) to DOA in July 1991, and has a dual reporting structure. LMIC is administratively located in InterTech and reports to it regarding GIS and related services. LMIC reports to IPO regarding geographic information policies and standards. In addition to LMIC staff, IPO has dedicated the equivalent of one staff position to help develop a data architecture, policies and standards and regarding geographic information in coordination with LMIC.

LMIC operates one of the earliest and most extensive state GIS in the country, particularly in terms of state financial commitments and variety of applications. LMIC is essentially funded as a service bureau, with almost 60% of LMIC's annual \$1.4 million budget, or approximately \$800,000, funded from service charges. General fund appropriations contribute the remainder of LMIC's revenue. The statute authorizing LMIC's move to DOA provides that fees can be set "reflecting the actual costs of providing the center's information products and services to clients."

LMIC is organized into five sections. The GIS Development and Operations Section is responsible for the operation, maintenance and upgrading of the system software and hardware. It also serves as a data clearinghouse and is responsible for data standards, data integration and the general development of databases. The GIS User

Applications Section provides a variety of GIS and related services, including application development for state and other agencies as a fee based service bureau. The DATANET Section provides support to DATANET, LMIC's information retrieval system. The Telecommunications and Offices Services Sections provides support for the other three sections.

LMIC has 27 staff members, 15 of whom are general funded positions including programmers, research analysts and engineering aides. A GIS personnel series has been prepared including five levels of specialists and a supervisor classification.

LMIC has a Prime 9955 II with ARC/INFO, Environmental Planning Programming Language (EPPL) versions 6 and 7, and ELAS software. ARC/INFO was purchased in 1983, and pcARC/INFO has also been acquired. LMIC is also in the business of marketing EPPL7 (see below). Data General workstations were purchased in 1990. Data networks are being developed with other agencies, particularly the Department of Natural Resources (DNR), to exchange data. LMIC and DNR have a 9600 baud line now, with plans to have an Ethernet connection.

The 1991 statute provided that LMIC "is to foster integrating of environmental information and provide services in computer mapping and graphics, environmental analysis, and small systems development." It was also authorized to "periodically study land use and natural resources on the basis of county, regional and other political subdivisions." LMIC provides GIS, mapping, modelling, graphics and database management services for state agencies and other governments. LMIC also maintains and markets an on-line information retrieval system named DATANET, Minnesota's largest on-line automated information retrieval system. DATANET contains facts, figures, and information about Minnesota, including demographics, economics, and natural resources, and also information about the United States. Initially developed in 1984, subscribers include libraries, schools, universities, and the private sector. The system is accessible for an annual subscription cost of \$200, which includes 10-15 hours of access.

DATANET PLUS MAPPING was developed to enhance DATANET with mapping capabilities. It is a menu-driven, personal computer-based mapping software package that allows users to acquire, manipulate, display and output data in tabular or map form. Developed in the late 1980s, the system allows tabular data to be related to geographic units and displayed to reveal patterns that may be overlooked during tabular data interpretation. The software operates on 80286 or higher personal computers and costs \$600. Which in-

cludes a one year subscription to DATANET. It includes boundary files of the United States by state and county, as well as Minnesota cities, townships and school districts. Over 200 licenses of DATANET PLUS MAPPING have been sold.

LMIC also maintains and markets EPPL7 (Environmental Planning Programming Language) software which was originally developed by the University of Minnesota for analysis, modeling and display of data. EPPL7 is a grid cell based GIS for use on IBM personal computers and compatibles. It was developed from EPPL6 which LMIC uses on its PRIME minicomputer system. LMIC and other agencies both in and outside Minnesota use EPPL7, including for example, the Iowa Department of Natural Resources and 13 foreign countries.

Since its establishment, LMIC has provided GIS services under contract with a variety of agencies, particularly the Department of Natural Resources (DNR). For example, LMIC conducted an assessment of mineral occurrences from field samples in 1986, and Phase I and II of the Forest Inventory Project being conducted in both Minnesota and Illinois with the U.S. Forest Service. A Memorandum of Understanding has been drafted between LMIC, the Department of Natural Resources (DNR), and the Pollution Control Agency (PCA). In the future a MOU might be signed with the Department of Transportation (DOT). The draft MOUs provide for collaborative efforts, and would help facilitate interchange of data and facilities.

*The Department of Natural Resources'
Northern Forest Birds Study is underway
to design and implement a long term
research and monitoring program to
investigate the response of forest bird
diversity to regional land use patterns.*

Other GIS projects include efforts with the Department of Energy and Economic Development in 1987 to create a Fishing Waters Map, with the Department of Agriculture's Soil and Water Conservation Board in 1987 to conduct a Statewide and Localized Erosion Assessment, the Environmental Quality Board in 1984 to assist in Nuclear Waste Siting, and with the Pollution Control Agency since 1981 for analysis regarding acid deposition and lead toxicity. A current project is the Northern Minnesota Land Dispute in which data on historic conditions in the late 1800s are being developed to understand original conditions.

Resulting maps will be used to help assess land values at the time treaties were established.

Digital data maintained at LMIC originally concentrated on the statewide 40-acre grid cell database based on data collected at the 1:250,000 scale that was initiated in the late 1960s at the University of Minnesota. Since the early 1980s LMIC GIS efforts have concentrated on individual thematic coverages including statewide coverage of rivers and lakes, detailed U.S. Soil Conservation Service soil survey maps for some counties, and land use data in the Twin Cities metropolitan area. LMIC maintains statistical, cartographic/mapping, and geographic databases. Other agencies are also developing digital data as part of individual agency missions, many of which are at the 1:24,000 scale, including county highway maps being developed by the Department of Transportation, land use inventory being conducted by the International Coalition, and state forest stands being developed by the Department of Natural Resources. Much of LMIC's current data development work is funded by the Legislative Commission on Minnesota Resources (LCMR) (see below).

The **Department of Natural Resources (DNR)** is Minnesota's primary natural resources management agency, including Divisions of Water, Minerals, Forestry, Parks and Recreation, and Fish and Wildlife, among others. The DNR is also responsible for managing the vast majority of state-owned land in Minnesota. The state has the third largest holding of land in the country. DNR has an agency-wide approach to GIS.

The DNR has had some GIS activity since the late 1960s as a key participant in the original Min-

nesota Land Management Information System (MLMIS). In addition to contracting with LMIC, DNR has had some in-house GIS capabilities since 1982 in the Division of Forestry. In 1989, the division purchased a Prime computer dedicated for GIS purposes on behalf of the department.

Currently DNR has an IBM RS 6000, model 530 in the Management Information Systems (MIS) Division for departmental needs. The Division of Forestry also has four Data General workstations. In addition, DNR has six licenses of pcARC/INFO, and 100 copies of EPPL7 were recently distributed to staff. Data networks are being developed with LMIC. Originally, consideration was being given to continue a trend of migrating from LMIC, but the DNR's current plans are to continue implementation of UNIX-based workstations and contract with LMIC to design custom interfaces. The DNR and LMIC now have a 9600 baud line, with plans to have an Ethernet connection. Discussions are underway between DNR and the Pollution Control Agency (PCA) to possibly have some joint computer operations.

DNR's GIS funding is provided from in-house program funds, as well as over \$3 million provided from LCMR for digital database development (see below). Funding for digital data is expected to increase in the future as 40% of LCMR's funds are constitutionally granted for natural resources from the proceeds of the state Lottery. Estimates are that over \$30 million may be generated for digital data development from LCMR per year by 1995. DNR's in-house annual dedicated funds for data, in addition to LCMR, are estimated to be almost \$2 million.

STATE OF MINNESOTA GIS PERSONNEL 1991 SALARY RANGES

Grade	Title	Minimum	Maximum
1	GIS Analyst	23,678	30,944
2	GIS Production Specialist	26,121	34,348
3	GIS Project Specialist	28,919	38,190
4	GIS Consultant	33,137	44,099
5	GIS Administrative Consultant	38,190	50,989
Supervisor	GIS Supervisor	40,403	54,037

It is estimated that over 30 staff members are using GIS in DNR. The MIS Bureau has three staff members working on GIS, including a MIS Planner. In addition, each division has staff, including seven in the Bureau of Engineering, four in the Division of Fish and Wildlife, three in the Division of Forestry, three in the Division of Waters, three in the Bureau of Real Estate, two in the Division of Minerals, one in the Division of Parks and Recreation, and six in the regions. DNR's GIS staff are classified as natural resource specialists.

The 1989 Legislature authorized a study to be conducted for the implementation of GIS in the DNR and appropriated \$90,000 for this effort. This report was completed in January, 1991 following a request for proposals issued in November, 1989. The report, entitled *Guidebook for Future Directions, Strategies, and Actions for the Minnesota Department of Natural Resources' Geographic Resource Information System*, concluded that the current GIS environment in the DNR is decentralized with a multiplicity of geographic information processing platforms. The plan states that the DNR challenge is to integrate all GIS activities without stifling and discouraging "GIS activists." It recommends the existing Information Systems Steering Committee be given more authority, and assign and enforce specific responsibilities and procedures for GIS development and operational tasks including standards.

In January 1991, the GIS plan was presented to the Legislature's Finance Committees which indicated support. Plans are underway to begin implementation, particularly of the plan's coordination recommendations. It was determined in the GIS plan that the development of a base map is the most crucial component of DNR's GIS efforts. The DNR has adopted 1:24,000 as the base scale for DNR's digital data efforts. Some of the data development and applications recommendations in the plan are on hold, with efforts in the DNR concentrating on the projects funded by LCMR and already underway and planned in the divisions. LCMR support includes over \$3 million of digital data development activity, including continuation of the County Biological Survey Program with \$1 million, completion of the National Wetlands Inventory and associated databases with over \$1 million, and groundwater sensitivity mapping at \$600,000.

In-house, the Northern Forest Birds Study is underway to design and implement a long term research and monitoring program to investigate the response of forest bird diversity to regional land use patterns. This project will be analyzing field inventory data using GIS techniques to develop forest landscape management tools. A relat-

ed project also funded by LCMR concerns the characterization and identification of old-growth forests.

The DNR is designing a comprehensive digital vegetation survey at the 1:24,000 scale. This project is being conducted department-wide with a field survey committee. The committee is enabling all DNR vegetative/habitat survey program managers to conduct a unified database design effort, resulting in a common, integrated ecological classification information system for Minnesota.

Applications

The **Division of Forestry** was the first division to use GIS in 1982, and has spent the most funds in developing GIS for internal needs. Phase I of two phases of a Forestry Inventory was initiated in 1985. Phase I included a statewide census of forestry for Minnesota for the U.S. Forest Service conducted under contract with LMIC. Phase II, a \$300,000 per year project with over seven assigned personnel, was also conducted by DNR and LMIC. This phase is to develop an inventory of state-owned forest stands for all public land survey sections containing state land, which amounts to 40% of the state. The primary purpose of this project is to assist in analyzing timber utilization and economic development. It is also useful for recreation and wildlife management.

The Legislative Commission on Minnesota Resources' total anticipated expenditure over the FY 1992-93 biennium will be \$8.1 million, which is perhaps the largest planned investment in geographic information of any state in the country.

The **Division of Fish and Wildlife** is one of the most active users of GIS in DNR. It maintains the Natural Heritage Information Management System (NHIMS) to assist in planning efforts to protect and manage Minnesota's endangered natural resources. NHIMS is being revised by the Minnesota County Biological Survey (MCBS) initiated in 1987. This effort is systematically collecting biological information on the distribution and status of rare plants, rare animals and natural habitats with LCMR funding assistance. Another project in the Division is the Deer Habitat Improvement Program (DHIP). Funds will be used to develop GIS databases, deer habitat applications, and software purchases.

The **Division of Waters** is actively working on the development of the 1:24,000 scale digital version of the National Wetlands Inventory with LCMR funding assistance. The division is acquiring the quadrangles and contracting with the U.S. Fish and Wildlife Service to produce this digital data layer. Palustrine, lacustrine and riverine wetlands and deep water habitats from the Protected Water Inventory, as well as watersheds are being digitized for inclusion in the database.

*Geographic information
and GIS coordination efforts
have been traditionally supported
by LMIC, which was relocated
by statute from the State
Planning Agency.*

The **Division of Minerals** is using GIS to assist in inventorying mineral ownership, including both private and public-owned lands. Previously, the Division contracted with LMIC to conduct an assessment of mineral occurrences from field samples in 1986.

The Minnesota **Pollution Control Agency** is responsible for environmental programs and regulation in the state. GIS activities were initiated in 1990 in the Water Quality Division to participate in efforts to help clean the Great Lakes. PCA has originally worked with LMIC, but decided to develop some in-house GIS capabilities in the Water Quality Division, and later encourage other divisions to use GIS. A personal computer is being used with pcARC/INFO and EPPL7 software. Educational efforts are underway in the division, as well as beginning work to conduct a pilot project to demonstrate the value of GIS for PCA needs. Efforts are underway in PCA to sign a Memorandum of Understanding with LMIC and DNR to facilitate collaborative efforts. Additional arrangements are underway to enable PCA to use DNR's GIS data and facilities.

The **Minnesota Geological Survey** is located at the University of Minnesota. It has contracted with LMIC for GIS services and has received funding for specific projects from the Legislative Commission on Minnesota Resources. A County Geological Mapping effort will be initiated in the 1992-93 biennium. Beginning in 1983, a Aeromagnetic Survey was initiated as an eight-year, \$3 million dollar project (with \$10,000 per year for GIS) to conduct an inventory of sub-surface geophysical conditions conducted by remote sensing methods to determine magnetic and gravity anomaly.

The **Public Utilities Commission (PUC)** is considering the use of GIS for a Utility Service Areas and Telecommunications Plan Support Project. Consideration is being given to begin this proposed project with LMIC in July, 1991 to inventory the state's telephone network, LATA zones, and service jurisdictions.

The **Department of Transportation (MnDOT)** is identifying GIS applications and benefits. A department-wide task force is being formed to address the issue. It is currently using an Intergraph system for CAD purposes, and has pcARC/INFO and AutoCAD for digitizing roads. MnDOT includes the State Geodetic Advisor partially funded by the National Geodetic Survey. MnDOT is participating in geodetic control densification with the U.S. Forest Service, the Federal Aeronautics Administration and the National Geodetic Survey.

The **Legislative Commission on Minnesota Resources (LCMR)** supported LMIC's GIS hardware purchase in 1979, and funded data development and planning for natural resources continuously since 1974. It is funding a large digital database development effort. LCMR's total anticipated expenditure over the FY 1992-93 biennium will be \$8.1 million, which is perhaps the largest planned investment in geographic information of any state in the country. Over \$2.2 million of the funds will be used for base map development at LMIC, including half the required match to participate with the U.S. Geological Survey for the 1991 statewide air photo flight, restart the state's topographic map revision program, and produce orthophoto maps for approximately two-thirds of the state, with the remaining third to be requested in FY 1994-95.

In addition, a variety of specific projects will be funded by LCMR. A Stream and Watershed Information System and a GIS control point inventory including known Public Land Survey section corners will also be funded in LMIC. The State Land Use program will be completed, and a grant to expand the applicability and use of GIS at the local level is also included in cooperation with LMIC and other groups. Funding is provided to the DNR to continue the County Biological Survey Program with \$1 million, complete the National Wetlands Inventory and associated databases with over \$1 million, groundwater sensitivity mapping at \$600,000, and also funding provided to Mankato State University for development of surface hydrology atlases and database in paper and digital form for 13 south central counties. Work granted to the University of Minnesota includes acceleration of the county soils surveys to complete them by 1993, and to produce county geologic atlases with the Minnesota Geological Survey, with each project to be over \$1 mil-

lion in expenditures.

The **Legislative Coordinating Commission** was allocated \$700,000 by the Legislature in 1989 for a system to conduct redistricting. The commission purchased five SUN workstations and is augmenting data developed by LMIC and the Metropolitan Council. This additional data includes transportation networks and precinct boundaries with other data to understand historic voting patterns and trends useful for reapportionment purposes.

Academic Activities

The **University of Minnesota in Minneapolis's** Department of Geography has a Digital Cartography Laboratory which serves as a teaching facility. Various classes in GIS are offered at the undergraduate and graduate levels. A project is underway with the Minneapolis city government to analyze hazardous materials using GIS. The University's Remote Sensing Lab received a grant of \$500,000 from the National Aeronautics and Space Administration to conduct a digital interpretation of forest cover statewide.

The **University of Minnesota** at Duluth is developing a GIS Facility Center in its Natural Resource Research Institute (NRRI). The center was partially funded by a \$348,000 grant from the National Science Foundation's Biological Facilities Centers Program with matching funds provided by the University. GIS is used at NRRI to research a variety of natural resource topics, including biological and ecological diversity. Seven grants from a variety of agencies, including the U.S. Environmental Protection Agency and the National Park Service, are funding over \$1 million in GIS research. One of NRRI's recent projects evaluated erosion rates along the north shore of Lake Superior which included an evaluation of aerial photography dating back to 1934 and using GIS to evaluate changes along the shore.

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Documents List

Directives

Executive Order 91-16: **Providing for the Establishment of a Governor's Council on Geographic Information**, September 16, 1991.

This order established the Governor's Council on Geographic Information, composed of not more than 15 members with "knowledge and interest in the GIS field representing state government, higher education, local government, federal government and GIS users in the private sector," as appointed by the Commissioner of Administration. It provides that a chair is to be elected. The Council is directed to adopt a charter and cre-

ate topical advisory committees. Administrative staff support is to be provided by the Information Policy Office, technical staff support by the Land Management Information Center, and advice from the Minnesota GIS/LIS Consortium. The Council is directed to prepare an annual report each year, with the first report due by June 30, 1992 including recommendations for legislation to establish a permanent organization to supersede the Council and recommendations for addressing needs described in the order.

*One of the University of Minnesota's
Natural Resource Research Institute's
recent projects evaluated erosion rates
along the north shore of Lake Superior
which included an evaluation of aerial
photography dating back to 1934
and using GIS to evaluate
changes along the shore.*



Laws of Minnesota 1991 345.2.10 (to be codified at 16B.92): **Transfer of Land Management Information Center from the State Planning Agency to the Department of Administration.**

This legislation directed that the Land Management Information Center "is to foster integrating of environmental information and provide services in computer mapping and graphics, environmental analysis, and small systems development. The commissioner, through the center, shall periodically study land use and natural resources on the basis of county, regional and other political subdivisions." It also provides that fees can be set "reflecting the actual costs of providing the center's information products and services to clients."

Laws of Minnesota 1989 335.1.28: **Directing a Study of Minnesota Land Resource Information Systems (LRIS)**, 1989.

This legislation directed that the State Planning Agency "commissioner shall contract with an independent consultant to explore future directions for Minnesota in LRIS. The study shall examine interagency cooperation, public and private venture potential, the status of GIS planning as it applies to Minnesota, the role that LMIC should play in future development of an overall system, the development of a long-range strategy for Minnesota's role in providing the appropriate services to agencies and political subdivisions. The study shall also explore the activities of other states and nations in the area of GIS. The study must be ac-

completed in conjunction with the information policy office and be compatible with the long-range information management architecture being developed by the information policy office. A final report shall be submitted to the legislature by January 1, 1991."

Memorandum of Understanding

DRAFT Memorandum of Understanding between the Minnesota Department of Natural Resources Management Information System Bureau, the Minnesota State Planning Agency Land Information Management Center, and the Water Quality Division of the Pollution Control Agency, April, 1991.

This draft Memorandum of Understanding (MOU) was created by the participants to better coordinate activities between the three entities. It provides for quarterly meetings among high-level representatives to set direction, discuss and resolve issues, and also quarterly project-level staff meetings to discuss technical and information service delivery issues. The MOU describes various internal activities that would be conducted in a collaborative manner, including technology, data architecture and standards development, as well as joint educational sessions. It also states the agencies will work together in establishing "cross-department GIS information management requirements and planning services for state and local government units."

Plans

Minnesota Land Resource Information Systems (LRIS) Strategic Plan, PlanGraphics, Inc., January, 1991.

This plan presents a statewide perspective on the management and coordination of GIS in Minnesota, as was directed by the Legislature during their 1989 session. It emphasizes the needs and means for the coordination of intergovernmental effort in developing, integrating, maintaining and using computer mapping and analysis. The plan includes an overview of GIS activities and conditions in the state, concluding that while Minnesota made an early commitment to a centralized, service bureau in LMIC, it is now faced with the challenge of adding database development, coordination and an information clearinghouse to meet the emerging needs of state entities. Identified objectives included development of geographic information databases for the entire state, a cooperative relationship with the public and private sector, and definition of roles with establishment of a governing organizational structure and funding mechanism for statewide GIS.

An action plan is proposed along four tracks including database development with standards and a database catalog; services to expand the

service bureau to include clearinghouse, consulting and training function; technology transfer including informational efforts; and management including planning and coordination of policy and procurement. Core database elements are proposed at the 1:100,000 and 1:24,000 scales. Three alternative organizational structures are proposed as stages of evolution to the third and recommended alternative. The plan recommends that eventually service bureau staff and facilities be moved to the InterTechnologies Group of the Department of Administration (DOA) which provides central information technology services for state agencies, and that policy and coordinating functions be located at DOA's Information Policy Office which coordinates statewide information policy and planning.

Guidebook for Future Directions, Strategies, and Actions for the Minnesota Department of Natural Resources' Geographic Resource Information System, PlanGraphics, Inc., January 10, 1991.

This plan was developed for the Department of Natural Resources (DNR) to implement an agency-wide, integrated Geographic Resource Information System (GRIS). It is accompanied by six working papers that were also written for the project. The plan concludes that the current GIS environment in the DNR is decentralized with a multiplicity of geographic information processing platforms. The plan states DNR's challenge is integrating all GIS activities without stifling and discouraging "GIS activists." It recommends the existing Information Systems Steering Committee be given more authority, and assign and enforce specific responsibilities and procedures for GRIS development and operational tasks. It also suggests the committee establish standards and make staff, equipment, and data conversion decisions for the GRIS, as well as administer GIS blocks of funds from the department or other sources. Attention to personnel considerations is recommended with appropriate funding for education. A long-term funding strategy is recommended, as well as database development. It was determined that the development of a base map is the most crucial component of DNR's GRIS efforts. The plan includes an evaluation of the business functions of each of DNR's divisions and bureaus, targeted and prioritized applications, and a five year implementation plan.

Request for Proposal

State of Minnesota Request for Proposal (RFP): A Study of Minnesota Land Resource Information System, August 14, 1989.

This request for proposals (RFP) is for consulting services to assist the state in exploring future directions for Land Resource Information Systems

(LRIS). The RFP was issued based on a requirement of 1989 legislation which directed the State Planning Agency to conduct an independent assessment of the state's needs, including interagency cooperation and public and private venture potential, among GIS issues. The RFP includes a discussion of GIS activities and progress in the state, including important entities and projects. It also includes strategic issues to be addressed in the study, including a description of the life cycle of a statewide LRIS and determination of the stage Minnesota is in and how it can prepare for the future. Additional issues were identification of driving forces to implement a state LRIS, the level of support needed to establish and maintain it, the appropriate functions to centralize and decentralize, procedures and funding mechanisms used to ensure the integration and access of common data, the scope of a second-generation database such as at the 1:24,000 scale, and the specific levels of effort of a state LRIS.

State of Minnesota Request for Proposal (RFP): A Study of Minnesota Department of Natural Resources Geographic Resource Information Systems, November 13, 1989.

This request for proposals (RFP) is for consulting services to assist the Department of Natural Resources (DNR) in exploring future directions for GIS implementation. The RFP was issued based on a requirement of 1989 legislation which authorized this study to define a future direction for DNR. It describes current activities and needs in the agency, roles of relevant state entities in and outside the DNR, strategic issues to be addressed, and selected automated and manual databases having geographic references.

Policies

Billing Policy and Rate Schedule for the Minnesota Land Management Information Center Service Bureau, Rates effective July 1, 1990 through June 30, 1991.

The Billing Policy and Rate Schedule provides information about rates and policies for use of the Land Management Information Center's facilities. It also provides information about priorities for work scheduling and policies regarding when a project will not be charged the full cost of service, such as when projects contribute to "common pool" databases or geographic coverages, those which have limited funding but are of major significance to the state, or those that can have processing discounts. LMIC offers computer time and staff services to non-government users if they are not in competition with private service providers.

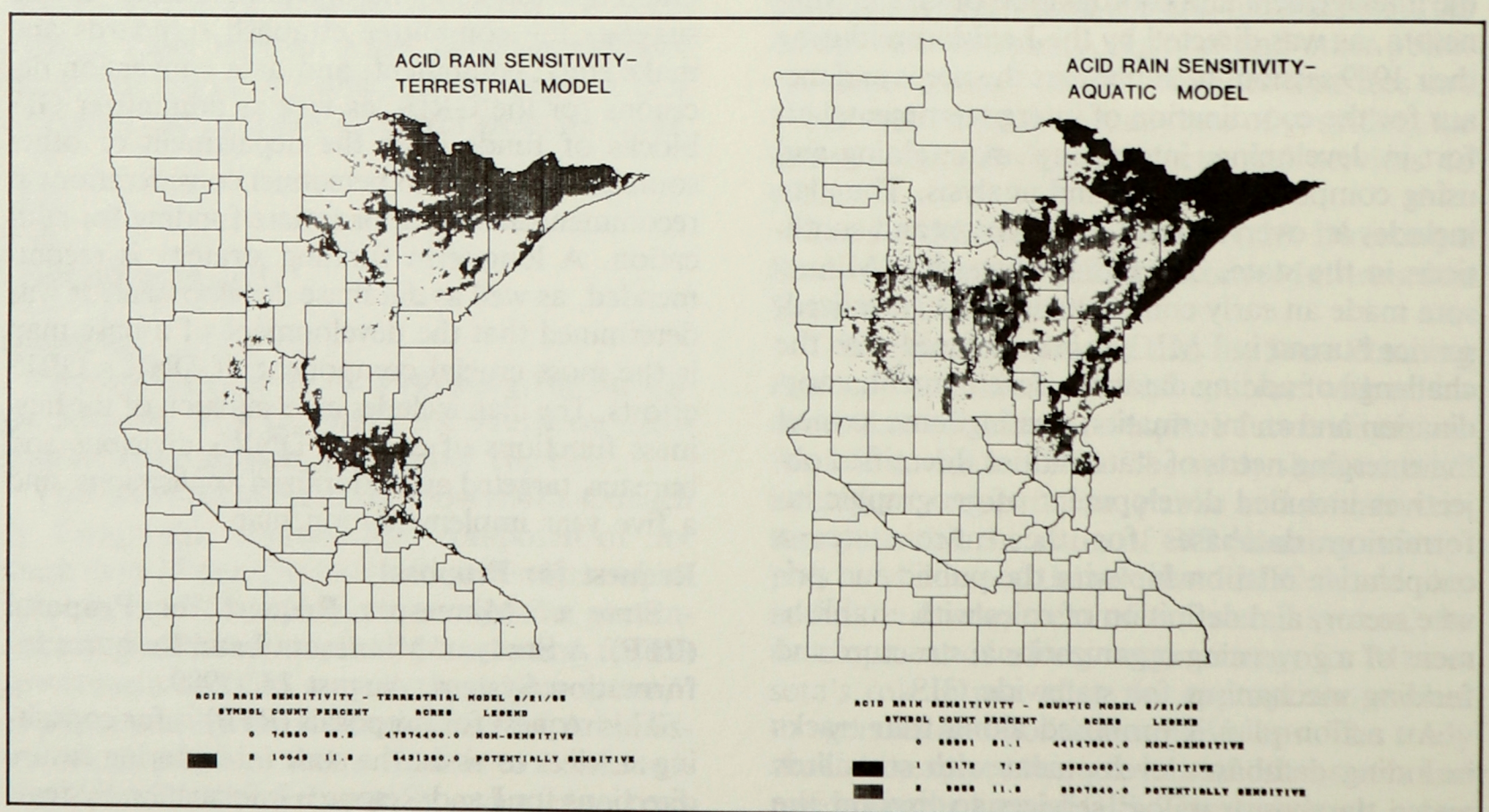
Position Descriptions

Progression of Responsibilities—GIS Specialist Series, Minnesota Land Management Information Center, August 30, 1990.

This set of position descriptions describes the progression of responsibilities for six GIS positions used by Minnesota's Land Management Information Center (LMIC). These positions include GIS Analyst, Production Specialist, Project Specialist, Consultant, Administrative Consultant and Supervisor. The Personnel Series is currently used for unclassified positions at LMIC.

Reports

Minnesota Geographic Data Integration Project: Report #1—1989 Annual Report, The Minnesota Natural Resources Geographic Infor-



mation Systems (NRGIS) Consortium, August, 1989.

This report is one of four reports produced by the "Minnesota Geographic Data Integration Project." The report explains the project and the concept of geographic data integration. The objectives of the project and the Natural Resources GIS Consortium (later renamed the GIS/LIS Consortium) are provided in the report. It also includes descriptions of the activities and recommendations of the consortium, and its steering committee and subcommittees. Future directions for data integration are provided, as well as a summary of digital data holdings available for Minnesota from state, federal and other agencies. Summaries of the other three reports produced by the project are also included in the report.

Minnesota Geographic Data Integration Project: Report #2—Inventory of Digital Data Collections, The Minnesota Natural Resources Geographic Information Systems (NRGIS) Consortium, August, 1989.

This report, the second of four reports produced as part of the "Minnesota Geographic Data Integration Project," includes a comprehensive inventory of digital data available for Minnesota. It provides a summary listing of data layers by theme, including hydrology, transportation, wildlife, soils, land use/land cover, land net, forestry, and minerals. A page of descriptive information is available for over 100 data layers, including unit of government, agency and contact name, information system, description, usage, source, source date, upkeep/update, geographic area, data transferability/format, and computer hardware/software. Status maps of digitizing projects for various data themes are also provided. The report also includes a review of major state and federal agency actors for each data theme.

Minnesota Geographic Data Integration Project: Report #3—Recommended GIS Standards, Guidelines, and Procedures: Building a Minnesota GIS Map Library, The Minnesota Natural Resources Geographic Information Systems (NRGIS) Consortium, August, 1989.

This report is the third of four reports produced as part of the "Minnesota Geographic Data Integration Project." It includes data classification and documentation standards including a proposed functional classification framework for the state's natural resources GIS. It also includes recommended data interchange standards, definition and procedures; and coordinates, control and projections. The report discusses software and data input using digitizing and scales and coordinate systems. The report states that LMIC is recommended to become a Minnesota GIS Map Library on a fee for service basis, which would

be processed by and archived in the ARC/INFO Map Librarian system.

Minnesota Geographic Data Integration Project: Report #4—Minnesota Data Exchange Research Project, The Minnesota Natural Resources Geographic Information Systems (NRGIS) Consortium, August, 1989.

This report is the last of four reports produced as part of the "Minnesota Geographic Data Integration Project." This report reviewed the need to exchange data between different systems and the reasons for the "Data Exchange Research Project." It includes an overview of ARC/INFO, AutoCAD and Intergraph software, and software translators and data conversion procedures including documentation about and evaluation of ARCDXF and DXFARC as part of ARC/INFO, AutoCAD's DXFIN and DXFOUT, ARCAD and ACADARC provided by ConRim Systems, Inc. and DXFIN and DXFOUT developed for Intergraph by Bentley Systems, Inc. Results of structured testing is provided, as well as data exchange file formats. Translation, system and procedural problems are identified, and questions for further research are also included.

1988 Minnesota Inventory of Computer Mapping Systems: Software, Graphic Data Files, and Expertise, Compiled by William J. Craig, for the Regional Mapping Consortium, 1988.

This directory includes information about computer mapping systems being used in the public and private sector in Minnesota in early 1988. It includes descriptions of users, contacts, assistance, technology in use, software specifications, current and future applications, access, graphic data files, attribute files and translation packages. It includes information on over 70 entities and has indices of users listed by software type. It provides a listing of needs assessments and vendor studies that have been completed or are underway.

Natural Resource Handbook: Land Use and Natural Resource Inventory and Trends, Planning Information Center, State Planning Agency, Department of Natural Resources, Office of Planning, Twin Cities Metropolitan Council, December 2, 1987.

This handbook includes a collection of maps, tables and fact sheets which summarize the condition of key natural resources in the Minneapolis-St. Paul metropolitan area. The collection of maps, data and trends are representative of the types of detailed information available in the State Planning Agency. The handbook also suggests good information sources for additional related information.

Newsletter

GIS/LIS News, Minnesota GIS/LIS Consortium, Published quarterly.